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Percolative Aspects of the Metal Insulator Transition in CMR Manganites

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Inspired by the strong experimental evidence for the coexistence of localized and itinerant charge carriers close to the metal-insulator transition in the ferromagnetic phase of colossal magnetoresistive manganese perovskites, for a theoretical description of the CMR transition we propose a two-phase scenario with percolative characteristics between equal-density polaron and Zener band-electron states. We find that the subtle balance between these two states with distinctly different electronic properties can be readily influenced by varying physical parameters, producing various “colossal” effects, such as the large magnetization and conductivity changes in the vicinity of the transition temperature. Detailed numerical studies concern the structure of the Zener band phase described by tight-binding fermions on a percolated cluster, in particular conductivity and localization properties of the corresponding wave functions.